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ABSTRACT

A study was conducted at the College of DuPage in Illinois to find out if peer-teaching and the utilization of students as laboratory aids could improve class performance, personalize instruction, and benefit the student. Two classes of highly motivated comparative anatomy students and two classes of less motivated second semester general biology students were involved in the experiment; one comparative anatomy class and one general biology class served as the experimental groups while the other two served as the controls. Both control groups were taught using the conventional method of laboratory instruction, involving a lecture-introduction and a demonstration on how to direct and to find the parts involved in the study, with the instructor providing individual help whenever possible. In addition, the experimental classes included direct peer involvement in teaching and learning of the assigned materials. For each class, a mean score and a standard deviation was computed for each individual unit examination, and students in experimental classes were asked to indicate their likes and dislikes of peer-teaching. Analyses of examination scores indicated that peer-teaching did not improve significantly the class performance of either group. However, student responses showed that the method gave greater insight into the subject and promoted fellowship among the classmates. (Author/UCM)

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PEER-TEACHING AND THE UTILIZATION OF STUDENTS AS LABORATORY TEACHING AIDS TO IMPROVE CLASS PERFORMANCE

by

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A PRACTICUM PRESENTED TO NOVA UNIVERSITY

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ABSTRACT

Due to tight budget at College of DuPage as in most schools, the student-teacher ratio is too great to provide personalized learning environment.

This study attempted to find out if peer-teaching and the utilization of students as laboratory aids could improve class performance, personalize instruction, and benefit the student.

Two classes of comparative anatomy and two classes of general biology were used in the investigation. The control groups were taught by conventional lecture-introduction and demonstration method. The instructors gave help whenever it was possible. In experimental classes, in addition to the above, there was direct peer involvement in teaching and learning. The examination scores of the experimental and the control classes were tested for significant difference at the $p \leq .05$ level utilizing the student t - statistics. The students were asked to indicate their likes and dislikes of peer-teaching. It was attempted to find out if there was a different effect of the methodology on the highly motivated comparative anatomy class and the less motivated general biology students. The findings of other educators were compared to the results of this study.

It was found that peer-teaching did not improve significantly the class performance of either group. Student responses, however, showed that the method gave greater insight into the subject and promoted fellowship among the classmates. Consequently, it was recommended to use peer-teaching whenever possible. In order to keep the laboratories open for study in the evenings and on weekends, it was advised to use the students as laboratory aids.

INTRODUCTION

At College of DuPage, as in most schools, the budget does not render to lessen student-teacher ratio. In many cases the instructor does not have enough time to interact with each student in order to provide proper guidance and atmosphere which would be favorable for learning.

The purpose of this practicum was to investigate if peer-teaching and the utilization of students as biology laboratory teaching aids could improve class performance. It was attempted to find out if this method of instruction could bring the student closer to the "instructor" and the "instruction" even though the class size was not reduced. It was attempted to find out if peer-teaching methodology would be perceived favorably by the students. If the results were to be positive, it was hoped that this method of instruction could be utilized in certain areas at College of DuPage, without creating a burden on the school budget.

Two classes of highly motivated comparative anatomy students, and two classes of not so highly motivated second semester general biology students were involved in the experiment. One comparative anatomy class and one general biology class served as the experimental group, while the other two served as the controls. In each case, comparing the experimental and the control group test scores prior to the investigation, it was found that based on the .05 level of significance, the class performance was similar.

A unit dealing with frog anatomy, and a unit of general histology was covered during the period of the investigation in the comparative anatomy class. A unit dealing with frog circulatory system was studied by the

general biology class. Though the comparative anatomy and the general biology classes were taught by different instructors, the same methodology of teaching was utilized during the period of the investigation.

In both cases, the control groups were taught by using the conventional method of laboratory instruction. There was a lecture-introduction and a demonstration on how to direct and how to find the parts involved in the study. The instructor gave individual help whenever it was possible.

The experimental groups initially followed the same procedure as the control. At the end of the instructor's introduction, however, there was direct peer involvement in teaching and learning the assigned materials.

After each unit, the students took a test. For every class a mean score and a standard deviation was computed for each unit examination. The mean scores of each examination, of the experimental and the control group, were tested for significant differences at the $p \leq .05$ level utilizing the student t - statistics. At the end of the investigation the students of the experimental classes were asked to indicate in writing if they liked the peer-teaching method and the utilization of students as laboratory teaching aids. They were asked to point out what they disliked about this methodology and in what way the peer instruction was helpful and beneficial to them. The student comments were summarized and used in the interpretation of the results of the investigation.

Following the designated unit of study, where peer-instruction was used, the conventional method of teaching was again utilized with the experimental as well as with the control group of the comparative anatomy class. The instructor made observations to find out if the students were going to continue to use the peer-teaching methodology and were going to ask the help of the formerly designated laboratory aids without her encouragement.

Literature was reviewed in order to find out how peer-teaching was utilized in other institutions and what benefits were observed in this style of teaching by other researchers. The results were compared with the findings in the present investigation.

Findings and recommendations were presented to the College of DuPage Administration.

BACKGROUND AND SIGNIFICANCE

It is a known fact that students have been teaching each other informally in and out of classroom for centuries. The values of peer-teaching have been investigated, especially on elementary and high school levels. This method has been used not only in the regular classroom, but also in cross-age teaching and in helping the socially and culturally handicapped children. Though most investigations were conducted in the areas of teaching language arts, it would seem that the basis behind the merits of this kind of teaching should be similar in all situations.

Because of the numerous benefits found in peer-teaching methodology at other institutions, it appeared that it would be beneficial to conduct an investigation at College of DuPage, in order to find out if it would be helpful to utilize similar methodology in certain areas of instruction like the biology laboratory. In discussing the theories of learning, Losah stresses that there are numerous approaches to learning and that there is a variety of learning styles.[1] In discussing diversification of education

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[1] John Losah, Learning Theory and Applications, (Fort Lauderdale, Florida: NOVA University, 1974), n.p.

formats Bakshis points out that "people learn in different ways. Some can absorb information from books, others need to learn through interactions with others."[2] Peer-teaching methodology definitely gives an opportunity for student interaction. The students have an opportunity to take the role of a teacher and of a learner. Gartner points out that:

> Learning through teaching works for a great variety of reasons, both cognitive and emotional. For the tutor, it provides feelings of competency and increases self-esteem, develops responsibility and maturity, and may even help overcome shyness. The tutor becomes active, participating learner, filling in gaps in his previous learning, which is now reinforced by new insight.[3]

The learner (the tutee) gets more individual attention and can get an immediate feedback on the knowledge of the subject or on his mistakes. In discussing the science of learning, Skinner expresses his belief that much of school activity is wasteful because rewards are not skillfully used. He believes that in order for the reinforcement to be effective, it must come within a matter of seconds, or a few minutes after the response has been made.[4] In peer-teaching, the immediate feedback-reinforcement is much more possible that when the instructor works alone with the students of a large classroom.

While deliberating peer-teaching, Gartner, Kohler and Riessman bring up another significant point. They point out that one learns how to learn by teaching. They state:

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[2]Robert D. Bakshis, "Diversification of Educational Formats. A Reanalysis and Extension of Research." Thesis Proposal, Illinois State University, Normal, Illinois, (January 13, 1972), p. 3.

[3]Alan Gartner, Mary Conway, Kohler and Frank Riessman, Children Teach Children: Learning by Teaching, (New York, N.Y.: Harper-Row Publishers, 1971), p. 135.

[4]B. F. Skinner, "The Science of Learning and the Art of Teaching." Harvard Educational Review, Vol. 24 (Spring, 1954), p. 86-97.

> It has long been obvious that children learn from their peers, but a more significant observation is that children learn more from teaching other children. From this a major educational strategy follows: namely that every child must be given opportunity to play the teaching role, because it is through playing this role that he may really learn how to learn.[5]

Ehly and Larsen recognize the merits of peer instruction by stating that "The student is an educational tool of great potential."[6] Even in counseling, student-counseling-student approach has been used at College of DuPage with great success. In discussing teaching, Rosenbaum points out:

> Teaching is ultimately the act of guiding someone through a network of planned experiences with the hope that in the process the learner will somehow develop means for coping with novel experience. Ideal guidance is guidance that does not permit the learner to stray from the path of relevant experience. (emphasized by the practicum author). Guidance thus implies sensitivity to the circumstances of the learner and the power to alter these circumstances; in short guidance means control.[7]

The communication structure in most classrooms is designed mainly for one-way transmittal of information. The guidance or the control is hard to achieve in a situation where the instructor has to deal with a large mass of students in a short period of time. It is not surprising that Rosenbaum points out that there is "the growing realization that conventional instructional methodology simply fails to be effective for the large segment of the population."[8]

Rosenbaum indicates further that the current terms like behavioral objectives, accountability and continuous progress instruction "reflects

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[5]Gartner, p. 1.

[6]Stewart Ehly and Stephen C. Larsen, "Peer Tutoring in Regular Classroom," Academic Therapy, Vol. 11, #2, (Winter, 1975-76), p. 205.

[7]Peter S. Rosenbaum, Peer Mediated Instruction, (New York, N. Y.: Teachers College Press, 1973), p. 1.

[8]Ibid, p. 3.

current urgent interests in the technolizing of instructional control for the express purpose of minimizing the cost of instruction with respect of desired educational ends."[9] Because of the rising cost of instruction, numerous different methodologies to approach the learner have been explored. Numerous individual learning packages and "teaching machines" have been designed to allow for individual differences and often to approach a large mass of students using few professional instructors.[10]

IPI (Individually Prescribed Instruction) associated with Robert Glaser and project PLAN (Program for Learning in Accordance with Need) developed by Westinghouse Learning Corporation and American Institutes for Research under John Flanagen, place emphasis on task learning. That is, when a student finishes a unit or a given task, he takes a test. If satisfactory score is not achieved, he can go back to learning exercises till he can master the unit successfully. The purpose of these tests, in these cases, is not to see if the student passed or failed, but to determine what he will do or study next. The student can go at its own pace, and he does get automatic feedback on the progress of each step as well as receives basis for the correction of the error. PSI (Personalized System of Instruction) uses course assistants and proctors in addition to the instructor for the purpose of handling larger mass of students.[11] CAI (Computer-Assisted

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[9]Ibid, p. 3.

[10]A. A. Lumsdaine and Robert Glaser, Teaching Machines and Programmed Learning, Department of Audio-Visual Instruction, National Education Association, (May, 1966).

[11]Philip G. Kapfer and Miriam B. Kapfer, Learning Packages in American Education, (Educational Technology Publications, Englewood Cliffs, New Jersey, 1972), n.p.

Instruction) is another method of very similar personalized learning.

In the above framework of teaching, the student has the responsibility to supervise himself. The objectives and content is fixed, it is dependent very highly on the quality of design and it is very expensive. The criticism of the "mechanized" teaching devices is not so much in the cost, however, but the impersonal aspects of this type of methodology. In these systems there is no real human contact which is needed by a large segment of the population. Thus effective teaching appears to be placed right back in the hands of the instructor.

As it was pointed out earlier, in a teacher-mediated learning environment, the supervision received by any student is directly related to the number of students in a given class. To defray the cost of small classes, many schools have utilized paraprofessionals, especially the graduate students, at the universities. Paraprofessional, is defined by Delworth as "a person without extended professional training who is specifically selected, trained, and given ongoing supervision and evaluation while performing some designated portion of the task, usually performed by the professional."[13]

The use of the paraprofessionals can be one way of lowering the number of students per "teacher" but, in most cases, it is effective only if this person works along with the professional instructor, for otherwise, there is a gap in the continuity of the instruction. This is expressed by

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[12]Robert A. Weisgerber, Developmental Efforts in Individualized Learning, (American Institutes for Research, F. E. Peacock Publishers, Inc., 1971), n.p.

[13]Ursula Delworth, Grant Sherwood, and Neff Casabuni, Student Paraprofessionals. A Working Model for Higher Education, (Washington: American Personnel and Guidance Association, Publications and Sales Department, 1974), p. 7.

most students who had the experience of being in a laboratory which was taught by a graduate student without the presence of the main instructor in the classroom. In times of limited finances for education, it is unlikely that the paraprofessionals will be incorporated in many classrooms to work together with the professional.

Thus, in view of the tremendous advantage of human contact in a learning situation, in view of the effectiveness of learning in an environment where there is greater "teacher" contact with the learner, in view of the staggering cost of hiring more professionals or even paraprofessionals, the possibility of using students as laboratory teaching aids and peer-teaching methodology appears to have great merit. As was expressed earlier, this method appears to be usable and beneficial not only because it does not create a burden on the school budget, but also, as it was already demonstrated in numerous institutions, it aids all the students involved, both in the role of a "teacher" and in the role of a student. For the above stated reasons, an investigation was conducted at College of DuPage to find out if, indeed, it would be beneficial to use peer-teaching methodology in a biology laboratory.

PROCEDURES

It should be noted that the term peer-teaching refers to one student teaching class related subject to another student.

Limitations

This investigation, dealing with peer-teaching methodology and the utilization of students as laboratory teaching aids had several limitations. First, the general time span of the practicum was relatively short and the

population number involved in this research was relatively small for a thorough investigation. Within the framework of the school quarter assigned tasks, it was impossible to give pretests before each unit of study even though this information would have been of value to the study.

A second factor which may be considered a limitation to the study was the fact that the students of both comparative anatomy classes were very highly motivated to learn the presented subject matter, for most of them had aspirations of entering some form of a medical field. Due to the high motivational factors, the methodology of teaching may not have shown a significant difference in the performance scores.

A third factor was the insufficient numbers of hours that was possible to devote, using peer-teaching methodology, in the general biology class, where the motivational factor was not as evident as in the comparative anatomy class. The four hours of class time, spread out over two weeks (two meetings), was not enough for real peer involvement. (It should be noted, that Don Sullivan, College of DuPage biology instructor, was kind enough to join the investigation using his general biology classes. Even though the quarter came to an end before more hours could be devoted to this method of instruction, his student written comments on peer-teaching were most beneficial).

Description of the classes involved in the investigation

Two classes of comparative anatomy were used at the onset of the study. The biology background of the students in both classes was relatively the same. Based on .05 level of significance, comparing the laboratory test scores prior to the investigation, one was able to see that statistically the class performance was similar:

Class	N	Laboratory Test I		Laboratory Test II	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
8:30 - 10:20 a.m.	19	33.10	5.32	81.10	12.46
8:30 - 12:10 p.m.	22	32.95	5.14	81.30	12.16

df = 39
t = .09
p ≤ .92

df = 39
t = .05
p ≤ .95

Toward the end of the quarter, two classes of second quarter general biology were incorporated in the study. The biology course was designed for non-majors, fulfilling the one year of science requirement for graduation. Based on .05 level of significance, comparing the laboratory test scores prior to the investigation, one was able to see that statistically the class performance as similar:

Class	N	Laboratory Test I		Laboratory Test II	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
Monday 8:30 - 10:20 a.m.	18	10.44	2.25	39.72	10.71
Wednesday 8:30 - 10:20 a.m.	22	9.59	2.06	42.36	7.43

df = 38
t = 1.23
p ≤ .21

df = 38
t = .88
p ≤ .37

As it was indicated earlier, the students of the comparative anatomy classes were a very highly motivated group. After another C.O.D. instructor in general biology area showed interest in peer-teaching idea, it appeared that even though the quarter was close to an end, it would be beneficial

to try this technique of teaching with a not so highly motivated, different biology class. It was hoped to obtain a comparison of the effectiveness of this method of teaching under a different set of conditions.

Description of the Units of Study

There were two units of study covered in each comparative anatomy class during the investigation where peer-teaching methodology was employed with the experimental group and the conventional teaching method was utilized with the control. The first unit consisting of 10 class hours dealt with the dissection and the study of frog anatomy. The second unit consisting of 5 class hours dealt with the study of histology.

At the end of the anatomy study unit the students were required to identify all body organs, know their functions as well as to be able to show all the major blood vessels and the path of blood flow. They were asked to relate all knowledge gained during the study of the frog to the human anatomy.

At the end of the histology unit the students were required to identify all parts and know the functions of the tissues and cells as indicated in the Histology Study Guide.[14]

The general biology students covered one unit of study dealing with the dissection of the frog blood vessels, their identification and the familiarization of the path of blood flow. The peer-teaching methodology time span lasted four class hours (two hours per week, during the two weeks of study).

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[14]Jura Vasiliauskas, Histology Study Guides, (Glen Ellyn, Illinois: College of DuPage, 1976).

The Interpretation and the Presentation of the Test Results to the Students

After each test the students were given a numerical score and a "translated" letter grade based on straight percentage: 90% through 100% = A; 80 through 89% = B; 65% through 79% = C; and 55% through 64% = D. These scores showed the students how they were doing at any one point. At the end of the quarter all points were to be added and a final grade was to be determined based on the percentages indicated above. In other words, a fluctuating curve based on class performance was never used.

Description of Procedure Steps

The 8:30 to 10:20 a.m. class of the comparative anatomy served as the experimental group, while the 10:30 a.m. to 12:20 p.m. class served as the control. In general biology, the 8:30 to 10:20 a.m. Monday class served as the control group, while the 8:30 to 10:20 a.m. Wednesday class represented the experimental. The control groups approached the units using the conventional laboratory teaching methods. There was a lecture-introduction, as well as a demonstration on the dissection of the animals to be studied. The students of the comparative anatomy class followed the Pictoral Anatomy of the Frog[15] study guide. The students of the general biology class followed the Laboratory Studies in Biology - Dissection of the Frog[16] guide. In comparative anatomy class, during the study of histology unit, the instructor gave short lecture-introduction. The photographs of the tissues were projected

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[15]Stephen G. Gilbert, Pictoral Anatomy of the Frog, (University of Washington Press, 1968).

[16]Warren F. Walker, Jr., Laboratory Studies in Biology - Dissection of the Frog, (W. H. Freeman and Company, 1967).

on the screen during which time each student was asked to find the given parts on the microscope slide. Parts and their functions were discussed. The students were asked to study further, using the indicated guide. In each case, the instructors gave individual help to the students whenever or wherever there was a need within the framework of the laboratory time.

The experimental group followed initially the same procedures for all units as the controls. At the end of instructor's introduction, however, there was direct peer involvement in teaching and learning the assigned material.

In all classes the students were able to take the specimen home or study in the laboratory during the open periods if they desired more than the alloted class hours.

The experimental groups were made aware of the utilization of peer-teaching methodology as well as the use of selected students as laboratory teaching aids. The control groups were not told of the alternate teaching method with the experimental sections or that they were involved in an experiment. The experimental groups were not told of the teaching method used with the control classes.

The criteria of selecting laboratory teaching aids were based on their excellence of past performance, their personality and their willingness to prepare and help in the laboratory. They did not receive extra credit or a stipend. The laboratory aids were pretested orally by the instructor in order to insure that they have a proper degree of competency prior to their helping other students.

Just like the instructors, the laboratory aids gave help to any student showing a need. In case of dissection, the students were able to

get directions, but the work was performed by them. The students were able to get pretests whenever they showed a desire to take them. Once the students gained certain degree of confidence in the area of a study, they were encouraged to start working in twos, alternating the role of a teacher and a student. They alternated in asking questions, answering questions, asking to show different parts and showing these parts. Any group study that developed was also encouraged.

After each unit the students took a test. For each class a mean score and a standard deviation was computed for each individual unit examination. The mean scores of each examination, of the experimental and the control group, were tested for significant difference at the $p \leq .05$ level utilizing the student t statistics:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{S_1^2/N_1 + S_2^2/N_2}} \quad 17$$

Without indicating their names, the students of the experimental class were asked to indicate if they liked the peer-teaching method and the utilization of students as laboratory aids. They were asked to point out what they liked and what they disliked about this method of teaching.

In the comparative anatomy class, the unit following the two units where peer-instruction was utilized, was again approached by the use of the conventional method of teaching in both classes, the experimental and the control. The instructor did not <u>direct</u> peer involvement in the experimental

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[17]George A. Ferguson, <u>Statistical Analysis in Psychology and Education</u>, (New York: McGraw Hill, 1966), p. 167.

class. Observations were to be made to see if the students did continue to use the peer-teaching method in the experimental group, even though there was no encouragement on the part of the instructor. Observations were made to see if the former student-laboratory aids played the role and were sought by their peers, even though they were not appointed by the instructor as the selected helping group. The behavioral observations were recorded and summarized in a statement form.

Three specific case-studies were presented to illustrate the effect of the peer-teaching methodology on the students.

Literature was reviewed in order to find out how peer-teaching was utilized in other institutions, what benefits were seen by other researchers using this style of teaching. The results were compared with the findings in the present investigation.

RESULTS

TABLE 1

Test Results Dealing with the Units of Study During the Period Utilizing the Peer-Teaching Methodology in Comparative Anatomy

Class	N	Laboratory Test 3		Laboratory Test 4		Total Points Possible
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	
8:30-10:20 AM Experimental	19	91.89	11.15	82.63	8.40	100
10:30-12:20 P Control	22	87.36	11.19	77.81	9.37	100

df = 39 df = 39

t = 1.29 t = 1.73

$p \leq$ = .19 $p \leq$ = .08

The mean scores on both tests of the experimental groups were higher than those of the control. Based on the .05 level of significance, however, t-test score comparing of laboratory examinations 3 and 4 showed no significant differences.

TABLE 2

Tests Results Dealing with the Unit of Study During the Period Utilizing the Peer-Teaching Methodology in General Biology Class

Laboratory Test Scores				
Class	N	$\bar{x}$	S.D.	Number of Questions
8:30-10:20 AM Monday-Control	18	16.33	2.32	18
8:30-10:20 AM Wednesday-Experimental	21	16.95	1.68	18

$df = 37$

$t = .93$

$p \leq .34$

Based on .05 level of significance, comparing the laboratory test scores, statistically the experimental group does not show significant improvement.

Student written responses to peer-teaching and the utilization of students as laboratory teaching aids in biology.

All of the students of the comparative anatomy and the general biology experimental classes responded very favorably to the peer-teaching methodology and the use of students as laboratory aids. They offered a variety of reasons for liking this method. The great majority of the students emphasized the value of the peer-teaching system because there was the accessability to numerous "teachers" where answers could be obtained quickly. It gave an opportunity to ask more questions.

Several students expressed the fact that they themselves learned while teaching their fellow students. It was like a continuous review and thus, they felt, they will retain the material longer. A great number of students pointed out that in cross-testing they had a chance to check their understanding of concepts and clear up misconceptions. Items were brought forth that they may have overlooked on their own. A number of students believed that because of cross-teaching and cross-testing they felt less pressure during the actual unit test.

One student brought out the fact that he felt added responsibility and a new incentive to learning while involved in peer-teaching methodology. He pointed out that the purpose of studying was more than just for a good grade. Another classmate concurred that there is more incentive to learn when one knows that he or she will be quizzed by a peer.

Gaining a better insight into the subject while teaching others was another favorable fact attributed to peer-teaching methodology. Learning a new approach to a given problem and new methods to memorizing facts was also linked to student involvement with each other.

One student thought that he could relate better to other students for he felt more on personal levels with them. Another person pointed out that this method is excellent experience for the anticipated teaching career.

The students felt that peer-teaching brought the class closer together and promoted fellowship among the classmates instead of maintaining the common separation of the good and the poor students. They emphasized the personal feelings that developed in helping the others.

Observations of student interactions during the post peer-teaching period in the comparative anatomy class

As the quarter progressed, even in the control class there was a certain degree of peer-teaching, even though this method was never directed by the instructor. In the experimental class, however, there was much more student involvement with each other, cross-teaching and cross-testing was still quite evident even though there was no encouragement by the instructor. The former laboratory aids still played a dominant role, though not as much as when they were in the "appointed" period.

Case Studies Illustrating the Effect of Peer-Teaching Methodology on the Students

Case 1. A low C male student, in his middle twenties, was very quiet and very reserved. Prior to the peer-teaching methodology, he never asked questions of the instructor, always worked by himself and never left his seat or made any attempt to interact with other classmates. During the peer-teaching period, he became involved in the "teacher" role as well as the student role. He began to ask questions of the instructor and he sought answers from other students. He still remained a shy, quiet, polite person, but he was not alone, he was part of a class and his subsequent tests came up to a B.

When he was asked what were the factors that brought up his grades, he attributed the increase to fewer working hours and peer-help. He pointed out that during peer-teaching, he did not feel that he was imposing upon his fellow student with his questions. He had the opportunity to get to know his classmates and he felt less pressure during the test periods.

Case 2. A young man, nineteen years old, was very popular with all the students. He was a very low C student. During peer-teaching period a group of students, all in fun, decided "to make sure" that from now on this young man will get B's. They taught him, they drilled him in and out of class. Indeed, he brought up his grade to a B and the "game" continued even after the designated peer-teaching period. The student did receive a B for his final grade.

Case 3. A young lady, nineteen years old, was a straight A student. She was an unusually quiet person and always by herself. During the peer-teaching period, she helped the weaker students; she had a tremendous amount of knowledge to contribute. After the designated peer-teaching period, unfortunately, she continued working by herself. However, it should be pointed out that since the students found out her abilities, they continued to seek her help even after the experimental period and thus, she had greater contact with her classmates than at the onset of the quarter.

DISCUSSION AND IMPLICATIONS

Reviewing the work of Gartner,[18] Rosenbaum,[19] and others, one finds that their investigations show that peer-teaching does raise the performance scores. Kopp points out that both the tutor and the tutee can gain valuable reading skills. He found that some tutors involved in the study gained as much as three years in reading skills in one semester.[20]

In this investigation, as indicated by Table 1, the mean scores of both tests of the experimental comparative anatomy class were higher than those of the control. Based on .05 level of significance, however, t-test score comparing of laboratory examinations 3 and 4 showed no significant difference. Travers states that "goal is an important factor in motivation."[21] As it was pointed out earlier, almost all comparative anatomy students had aspirations of entering some form of medical field. They were aware of the importance of the grade point and the need of suitable preparation for the highly competitive medical schools. Consequently, the lack of significant improvement of the experimental class, in this case may be attributed to the student high motivational factor to achieve a good grade and thus, the affect of methodology of teaching may not have been exemplified in the test scores.

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[18]Gartner, n.p.

[19]Rosenbaum, Peer-Mediated Instruction, n.p.

[20]Frederick S. Kopp "Evaluation of the Youth Tutoring Youth Program," Research and Development Report, Vol. 6, #10 (Summer, 1972), ED075 560.

[21]Robert M. W. Travers, Essentials of Learning, New York, N. Y.: Macmillan Publishing Co., Inc., 1972), p. 384.

Table 2 shows that peer teaching did not improve the performance of the general biology class, where the students did not have the interest or the motivation of the comparative anatomy groups. In this case, the lack of improvement may be attributed to the short period involving this method of teaching. As it was pointed out earlier, the peer teaching time span in this class, lasted four class hours (two meetings) within a two week period. There was not enough continuity or enough contact for real peer involvement. The test sample was very small for obtaining conclusive results.

Though the test scores of the experimental classes did not show encouraging gain, it was impressive to note that all students echoed similar statements concerning the advantages and the profit from peer-teaching methodology. It was significant to observe that the students who used this learning technique for a short period of time and were less motivated, saw the same benefits of peer-teaching as the members who used the method for much longer period and had high incentive for learning the presented subject matter. All of these students responded very favorably to peer-teaching methodology and the use of students as laboratory aids. Their written responses brought forth many observations that were made by other researchers and educators.

A great majority of students stressed the value of the peer-teaching system because there was the accessibility to numerous "teachers" where answers could be obtained quickly. It gave an opportunity to ask more questions. Losak points out that "learning is improved by rapid information feedback."[22] Skinner also believes that in order to be effective, the

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[22]Losak, p. 42

reinforcement must come within a matter of seconds or few minutes after the response has been made.[23] Whether in the case of answering a question or in the feedback of success, or the correction of error, a single instructor in a classroom cannot be available to all students at all times. In the peer-teaching system, however, the fulfillment of these needs could materialize much more readily.

Several students expressed the fact that they themselves learned while teaching their fellow students. They felt that the teaching situation created a setting for continuous review and thus, they felt that they will retain the material longer. Great number of students indicated that in cross-testing they had a chance to check their understanding or concepts as well as to clear up misconceptions. They indicated, that in some cases, items were brought forth that they may have overlooked on their own. A number of these students believed that because of cross teaching and cross-testing they felt less pressure during the actual unit test. Most of these statements concur with the observations of Rosenbaum,[24] Gartner,[25] Bruner,[26] and other educators.

Another important observation made by students was the fact that they felt added responsibility and a new incentive to learning while involved in the peer-teaching methodology. The purpose of studying, in this case,

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[23]Skinner, n.p.

[24]Rosenbaum, n.p.

[25]Gartner, n.p.

[26]Jerome S. Bruner, The Process of Education, (New York, N. Y.: Vintage Books, 1963), n.p.

was more than just for a grade. Numerous students felt that they gained better insight into the subject while teaching others. Learning new approaches to a given problem and new methods to memorizing facts was also linked to student involvement with each other. These thoughts are expressed by several educators. Bruner, for example states:

> Mastery of the fundamental ideas of a field involves not only the grasping of general learning, but also the development of an attitude toward learning and toward guessing and hunches, toward the possibility of solving problems of one's own.[27]

Gartner elaborates these ideas further by stating:

> The child who teaches another child and thereby learns himself, not only has to struggle to make the material meaningful to the learner, but also has the opportunity of observing another in the process of learning, perhaps leading him to reflect upon his own learning process.[28]

Whitfield states that in order to teach, a student has to learn the material himself. Just like the students of this investigation, he recognizes the added responsibilities upon the peer-teacher.[29] Gartner states number of reasons why the student gains better insight into the subject while teaching others:

> He reviews the material; he has to organize, prepare, illustrate the material to present it to his students; he may try to reshape or reformulate it so as to enable his pupil to learn it and thus himself sees it in new ways; he may need to seek out the basic character of the subject, its structure, in order to teach it better, and may thereby himself understand it better.[30]

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[27]Burner, p. 28.

[28]Gartner, p. 62.

[29]Eddie Whitfield, "The Weather is Fine for Peer Teaching," Science and Children, Vol. 14, (October, 1976), p. 25-26.

[30]Gartner, p. 62-63.

In discussing his perspectives on the concept of peer-teachers, James Godshalk, Director of Counseling and Testing Services at College of DuPage, expressed his support, for he felt that the effectiveness of this teaching technique could be due to the "student-teacher" peer identity. He felt that "peer-teaching moves us a little bit closer toward the concept of everyone being a teacher and a learner."[31] He felt that this methodology increases "the amount of caring and personal interaction between students."[32] It is significant to note that the experimental class student written comments expressed similar feelings. One student indicated that he could relate better to other students, for he felt more on a personal level with them. The students felt that peer-teaching brings the class closer together and promotes fellowship among the classmates instead of maintaining the common separation of the good and the poor students. They also emphasized the gratification of personal feelings in helping others.

The social and emotional benefits of peer-teaching are also recognized by other educators. Rosenbaum noticed that when two children learn together, they become involved with the subject, and each other on personal and emotional level.[33] Gartner elaborates further by stating:

> Programs of children teaching may not only lead to direct cognitive effect but may also have emotional, social and psychological impact that in turn may affect cognitive growth, as well as having benefit in and of itself.[34]

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[31] James Godshalk, "Some Perspectives on the Concept of Peer-Teachers," (A personal memo submitted to Jura Vasiliauskas by the Director of Counseling and Testing Services at College of DuPage, Glen Ellyn, Illinois, March 2, 1977).

[32] Ibid.

[33] Peter Rosenbaum, "Learning Two by Two," Teacher, Vol. 93, (March, 1976), p. 58-59.

[34] Gartner, p. 63.

It was interesting to observe that as the quarter progressed, even in the control class there was a certain degree of peer-teaching taking place, even though this method was never directed by the instructor.

After the instructor-mediated peer-teaching period, two more units of study were taught in the former experimental class of comparative anatomy using the conventional lecture-demonstration technique. The instructor gave help whenever it was possible. Comparing the experimental class with the control, it was found that in the former, there was much more student involvement with each other. The cross-teaching and cross-testing was still quite evident even though there was no encouragement by the instructor to use the peer-teaching methodology. The former laboratory aids still played a dominant role, though not as much as when they were in the "appointed" period. Thus, it appears that peer-teaching was benefiting the students. Since they continued to use this methodology of teaching and learning, it must have satisfied some of their needs.

One student stated that peer-teaching gave her excellent experience for anticipated teaching career. Case study 1 and 3 showed that peer-teaching can help the shy and the withdrawn student. In this situation, the shy student was asked questions, and had to ask questions on one-to-one level, in more personal atmosphere. As in case study 1, he may gain academically. It gave the opportunity for the gifted shy person to share her knowledge, as it was indicated in case study 3, and thus may have had an impact in the social and in the emotional domain. This fact was also noted by Gartner who states: "The effect of teaching others upon the youngster who is teaching may be as simple as overcoming shyness, changing the reticence of a loner."[35] Case study 2, shows that peers can help the poor

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[35] Gartner, p. 67.

or the less motivated student academically. They can create a "group therapy" situation where the student, being part of a group, performs differently than when he is on his own.

It should be noted that there are times when a student must and should study by himself. This would depend on the subject matter and on the objectives of the study unit. On a whole, however, it appeared that the students worked more productively when they worked together.

In the peer-teaching situation, the instructor, instead of being just a dispenser of knowledge could become the manager of learning. As Rosenbaum points out, the buddy-system activities can be easily managed and could be organized at any level of complexity. The technique is flexible and will be applied in different learning settings.[36]

As indicated earlier, the tests were graded on straight percentage. A fluctuating curve was never used, for it was felt that this method of evaluation is not conducive to learning, especially in a peer-teaching situation. Many students have expressed the fact that it is unfair to grade on a fluctuating curve where elevated class performance results in the raising of a percentage for a given grade. Receiving a grade "at the expense of others" would have resulted in information withdrawal rather than sharing. It would have defeated the whole concept that there can be an enrichment in peer-teaching. This view is also expressed Gartner, who in discussing Abt's ideas, states: "Having developed strength by and learning from helping another, as contrasted with doing so at the expense of another, may lead the individual to self-growth and individual learning as part of a cooperative collegial relationship, not necessarily one of competi-

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[36] Rosenbaum, "Learning Two by Two," n.p.

tion or at the expense of another."[37] After all, education is not just dispressal or the acquiring of facts and figures, like Thorndike states, "Education as a whole should make human being wish each other well."[38] McClellan also recognizes this fact when he writes that "Some educators who are explaining the dynamics of helping relationship structures which can be fostered in the classroom are doing so because they believe that education is living, not just preparation for life, and that the experiences in our classrooms should reflect this belief."[39]

Thus, in this investigation, though peer-teaching and the utilization of students as biology laboratory teachings aids did not improve significantly the class performance level, it appears that the method helped the students beyond grades. It created a collegial learning atmosphere and it created multi-teacher environment where answers could be obtained quickly. Peer-teaching situation gave the students the opportunity to ask more questions, it fostered confidence, added motivation to learning, and provided deeper insight into the subject. It involved the loaner and it offered fulfillment on the part of the helper. It gave the opportunity for the weak students to interact with the strong, find new ways to learn and increase the awareness of the patterns of learning. It provided the chance to experience the position of a teacher as well as a student. Peer-teaching added new responsibility, new incentive to learning and promoted fellowship among the classmates.

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37 Gartner, p. 66.

38 Geraldine M. Joncich, ed., Psychology and the Science of Education, Selected Writings by Edward L. Thorndike, (New York, N. Y.: Bureau of Publications, 1962), p. 57.

39 Billie Frances McClellan, "Student Involvement in the Instructional Process Through Tutoring," ERIC ED055046, (June, 1971), p. 3.

RECOMMENDATIONS

In view of the investigation findings, and in view of the results found by other educators dealing with peer-teaching or peer-tutoring, it is recommended that the college instructors would be encouraged to use this methodology of teaching whenever possible.

It is a known fact that in the field of biology, the students often need more time in laboratory than the scheduled classes can provide. In order to keep the laboratories open for study in the evenings and on weekends, selected students could serve as laboratory aids. It would be reasonably inexpensive and extremely beneficial to all students concerned. The aids could handle reference materials, microscopes and even give individual help. They could serve better than the outside paraprofessionals, for they would know the problems of their peers and they would maintain the peer identity.

Time permitting, a "mini-course" may be developed to give a stronger base for the helper.

It would be ideal if the school finances would allow the establishment of biology self-learning center, where there would be an extensive reference library, self-paced learning modules, individually prescribed learning machines combined with the student teaching aids. It would be beneficial to have a conference area for group and individualized peer-teaching, laboratory dissecting and similar learning activities.

Until there are more funds, it is recommended not to ignore students as educational tools. As Godshalk points out, peer-teachers can serve many functions; they can give help to the fellow students, they can act as liaisons

between the instructor and the student to provide systemic input into the teaching/learning process. "Peer teachers are increasingly needed to maintain personal contact with students as course involvements expand in a time of limited finances for education."[40]

Ecclesiastes summarized, in very illustrative way, the advantage of peer-teaching when he stated:

> Two are better than one; because they have a good reward for their labour. For if they fall, the one will lift up his fellow; but woe to him that is alone when he falleth; for he hath not another to help him up.[41]

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[40] Godshalk, appendix 1

[41] Ecclesiates, Old Testament, iv, 9-10.

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